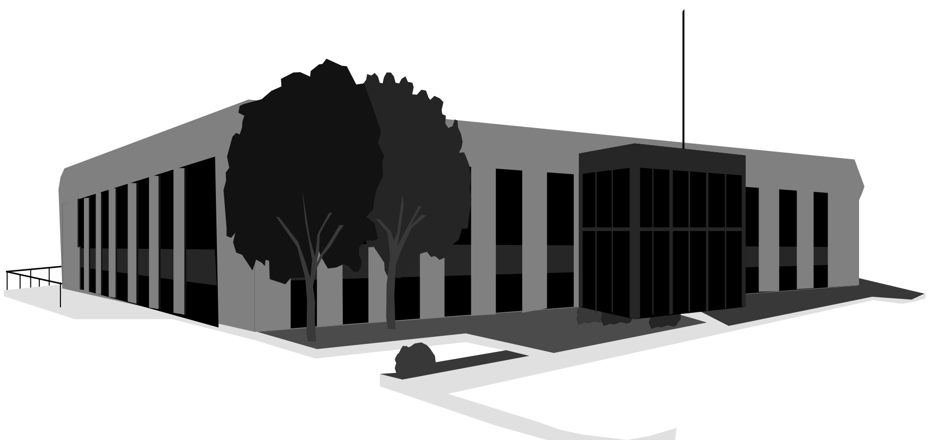
INDOOR AIR QUALITY ASSESSMENT

Greenfield Middle School
195 Federal Street
Greenfield, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
June, 2000

Background/Introduction

At the request of the Lisa Herbert of the Greenfield Board of Health, the Massachusetts Department of Public Health (MDPH) Bureau of Environmental Health Assessment (BEHA) was asked to provide assistance and consultation regarding conditions within the Greenfield Middle School (GMS), Greenfield, Massachusetts. The GMS has been undergoing complete renovation.

On April 14, 2000, a visit was made to this school by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. Brooks Fulton, Clerk of the Works for the Greenfield Middle School Construction & Renovation Project and Ms. Herbert accompanied Mr. Feeney during the assessment. This request was prompted by reports of possible bird infestation and water damage to the interior of the building.

The GMS is a two-story brick building with a basement. At the time of the assessment, the building was unoccupied and renovations were partially completed. Window frames, dry wall and flooring were laid. The heating system with insulation was in place. Heating, ventilating, and air-conditioning (HVAC) system ductwork was installed in hallways, however classroom ceilings and accompanying ductwork and air diffusers were not in place.

As reported by Mr. Fulton, the building has experienced water damage from water penetration resulting from displaced roof drainpipes. Mold testing was conducted on February 10, 2000 (ATC, 2000). ATC noted bird waste and significant water damage to walls and flooring in the building. ATC concluded that microbiological testing found mold and bacterial growth. ATC recommended that bird waste be cleaned and disinfected by individuals with personal protective equipment. It was also recommended that water damaged flooring by replaced.

Methods

Water content of flooring and wall paint was measured with a Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe. Moisture measurements were made in several areas of the building. Observation of interior space of wallboard was accomplished by inserting a Professional Equipment boroscope through pre-existing holes in the wallboard(s). Temperature and relative humidity were taken with the Mannix, ThPen PTH 8708 Hygrometer/Thermometer.

Results/Discussion

The building was evaluated during a sunny day, with an outdoor temperature of 56^{o} F and relative humidity of 18 percent. No active leaks were observed and no visible, accumulated moisture was noted on walls. No mold-type odors were noted in the building, with the exception of a dirt-lined pit in the floor were water utility pipes enter the basement. Standing water was noted in soil in and around the boiler room. Relative humidity indoors was measured in a range of 11 to 18 percent. The floor system appeared to be plywood laid over tongue-in-groove maple (see Picture 1). The supporting structure beneath the floor wood is brick (see Picture 2). The source of water-damage to the building was attributed by Greenfield town officials to the removal of drainpipes connected to roof drains. Former roof drains missing drainpipes were noted in the building (see Picture 3). Plywood flooring appeared dry, however plywood around seams in the floor appeared to be water stained (see Picture 4). Seams of plywood also appeared to be widened due to shrinkage. Moisture readings taken at random were either non-detectable or in a range of 8.0 to 8.7 percent in the plywood floor with measurable levels of moisture. The tongue-in-groove maple floor yielded a moisture content measurement in a range of 10.2 to 10.7 percent.

The floor in the proposed faculty dining room in the basement had a moisture content range of 9.0 to 22 percent. The floor nearest the exterior wall had the highest moisture content readings. The interior side of the exterior wall of this room exhibited signs of water staining and efflorescence, which indicates water penetration. A likely source of moisture in the basement is rainwater penetrating through the foundation. The soil outside the building at this wall appears to be graded towards the building. This condition can direct rainwater to the base of the exterior wall, which can lead to pooling. Pooling water in contact with exterior brick can lead to water penetration, which results in the production of efflorescence in brick surfaces.

Efflorescence is a characteristic sign of water intrusion. As penetrating moisture works its way through mortar around brick, it leaves behind characteristic mineral deposits. The soil outside this wall is barren of vegetation and is sloped *toward* the basement wall. This configuration allows rainwater from the roof to pool at the base of this wall. As water penetrates into the basement, the dirt floor absorbs this moisture and can begin to serve as media for mold growth. Mold grows in cycles, which creates spores, mold fragments and other related problems. These particles can become aerosolized with increased airflow over contaminated materials.

Building materials can also absorb moisture from air. As relative humidity increases, moisture concentration can increase. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Once mold growth has occurred, disinfection of these materials may be possible, however since wood is a porous surface, disinfection may be ineffective. Please note that the moisture testing was done on exposed surfaces of floor. If water were to flood a floor, it is possible that moisture could become trapped beneath the plywood and/or maple flooring to serve as a reservoir for moisture. Care should be given in selecting a floor covering that would not support mold growth if these moisture reservoirs exist. Further moisture testing on the sub-flooring should be done to determine if these moisture reservoirs exist.

Plaster and paint in stairwells exhibited signs of water damage. Flat paint surfaces did not have measurable levels of moisture. Moisture measurements in bubbled paint (see Picture 5) or exposed plaster were non-detectable. The interior of bubbled paint on this wall had moisture measurements in a range of 18 to 41 percent, indicating water accumulation behind the paint surface. Both paint and wall plaster can serve as growth media for mold, especially if wetted repeatedly.

Ductwork was partially installed in the building. Openings to ductwork were noted in classrooms through interior walls above hallway doors (see Pictures 6 through 8). Each of these duct openings was not sealed to prevent renovation-generated dust. Ductwork to be installed was found stored on the floors of classrooms (see Picture 8). These ducts were heavily coated with dust (see Pictures 9 and 10). It is good practice to isolate newly installed ductwork to avoid dust contamination of these materials. Since it appears that these ducts were open throughout the building, there is ample opportunity for both installed and/or stored ductwork to be contaminated by renovation pollutants. Therefore, the design of the ductwork system must be assessed to determine how it may be impacted by renovation activities.

Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and utilizing filters with a higher dust spot efficiency where needed (SMACNA, 1995). Ductwork exposed to renovation pollutants should be cleaned to prevent the ventilation system from serving as a reservoir of pollutants once the ventilation ductwork installation is completed and the HVAC system is activated.

Numerous openings to the buildings were noted (see Pictures 11 and 12). Signs of pigeon infestation including pigeons, feathers (see Picture 13) and pigeon waste (see Picture 14) were noted in numerous indoor areas. Insulation on pipes appeared to be contaminated with pigeon waste (see Pictures 15). In one case, it appears that bird's have nested inside ceiling brickwork. Significant bird waste was noted along a catwalk above the auditorium stage (see Pictures 16 and 17). Bird wastes in a building raise three concerns: 1) diseases that may be caused by exposure to bird wastes, 2) appropriate measures for clean up of bird waste and 3) the appropriate method for disinfection of plywood.

Disease Associated with Bird Wastes

Certain molds are associated with bird waste and are of concern for immune compromised patients. Other diseases of the respiratory tract may also result from exposure to bird waste. Exposure to bird wastes are thought to be associated with the development of hypersensitivity pneumonitis in some individuals. Psittacosis (bird fancier's disease) is another condition closely associated with exposure to bird wastes in either the occupational or bird raising setting. While immune compromised individuals have an increased risk of health impacts following exposure to the materials in bird waste, these impacts may also occur in healthy individuals exposed to these materials.

Clean Up Methods

The methods to be employed in clean up of a bird waste problem depend on the amount of waste and the types of materials contaminated. The MDPH has been involved in several indoor air investigations where bird waste has accumulated within ventilation ductwork (MDPH, 1999). Accumulation of bird waste have required the clean up of such buildings by a professional cleaning contractor. In less severe cases, the cleaning of the contaminated material with a solution of sodium hypochlorite has been an effective disinfectant (CDC, 1998). Disinfection of non-porous materials can be readily accomplished with this material. Porous materials contaminated with bird waste should be examined by a professional restoration contractor to determine if the material is salvageable. Where a porous material has been colonized with mold, it is recommended that the material be discarded (ACGIH, 1993).

Worker Protection

The protection of both the cleaner and other occupants present in the building must be considered as part of the overall remedial plan. Where cleaning solutions are to be used, the "cleaner" is required to be trained in the use of personal protective methods and equipment (to prevent either the spread of disease from the bird wastes and/or exposure to cleaning chemicals). In addition, the method used to clean up bird waste may result in the aerosolization of particulates that can spread to occupied areas via openings (doors, etc.) or by the ventilation system. Methods to both prevent the spread of bird waste particulates to occupied areas or into ventilation ducts must be employed. In these instances, the result can be similar to the spread of renovation-generated dusts and odors in occupied areas. To prevent this, we would recommend that the cleaner employ the methods listed in the SMACNA Guidelines for Containment of Renovation in Occupied Buildings (SMACNA, 1993).

Conclusions/Recommendations

A number of areas of bird waste contamination and water damage exist in the building. The following recommendations should be implemented in order to mitigate bird waste and other pollutants.

1. Remove birds from the interior of the building and seal all means of egress for birds to enter the building.
2. Clean bird wastes from contaminated materials. Remove accumulated bird wastes from flat, non-porous surfaces and disinfect with an appropriate antimicrobial agent. Once disinfected, each treated area should be cleaned to ensure the removal of residual bird waste and cleaning materials. Removal of contaminated porous materials (e.g., pipe insulation) may be the only appropriate measure to remove bird wastes from these materials. In order to assist you with this project, we have enclosed a copy of an issue of the Centers for Disease Control *Morbidity and Mortality Weekly Report* for July 10, 1998 (see Appendix A), which covers the clinical aspects as well as clean up associated with bird waste. Dependent on the scale and scope of the contamination, you may wish to consider consulting a professional cleaning company that has had experience in cleaning buildings that have experienced bird infestations.
3. Evaluate whether moisture pools from water damage exist beneath plywood and/or maple flooring. If moisture pooling exists, employ appropriate methods to both remove moisture and disinfect mold contaminated materials. If mold contamination exists and disinfection is inadequate, consider removing materials.

4. Flooring in the basement should be examined for mold growth. If mold growth exists, disinfect contaminated materials. If mold contamination exists and disinfection is inadequate, consider removing materials.
5. Re-grade ground surface to ensure water drainage away from the base of the building. If not feasible, consider installing a water drainage system at the base of the building to remove accumulating rainwater.
6. Clean all uninstalled ductwork of dust and store in a manner to prevent contamination with renovation-generated dust.
7. Clean the interior of all installed ventilation system ductwork. Seal each end of installed ductwork to prevent contamination.
8. Remove bubbled paint and examine wall plaster for mold growth. If mold growth is present, disinfect with an appropriate antimicrobial agent.
9. Seal construction barriers with polyethylene plastic and duct tape to create a secondary barrier to prevent migration of renovation generated pollutants into finished areas.
10. Implement prudent dust control procedures to minimize dust generation inside the building. This may include constructing barriers, sealing off areas, and temporarily relocating furniture and supplies. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

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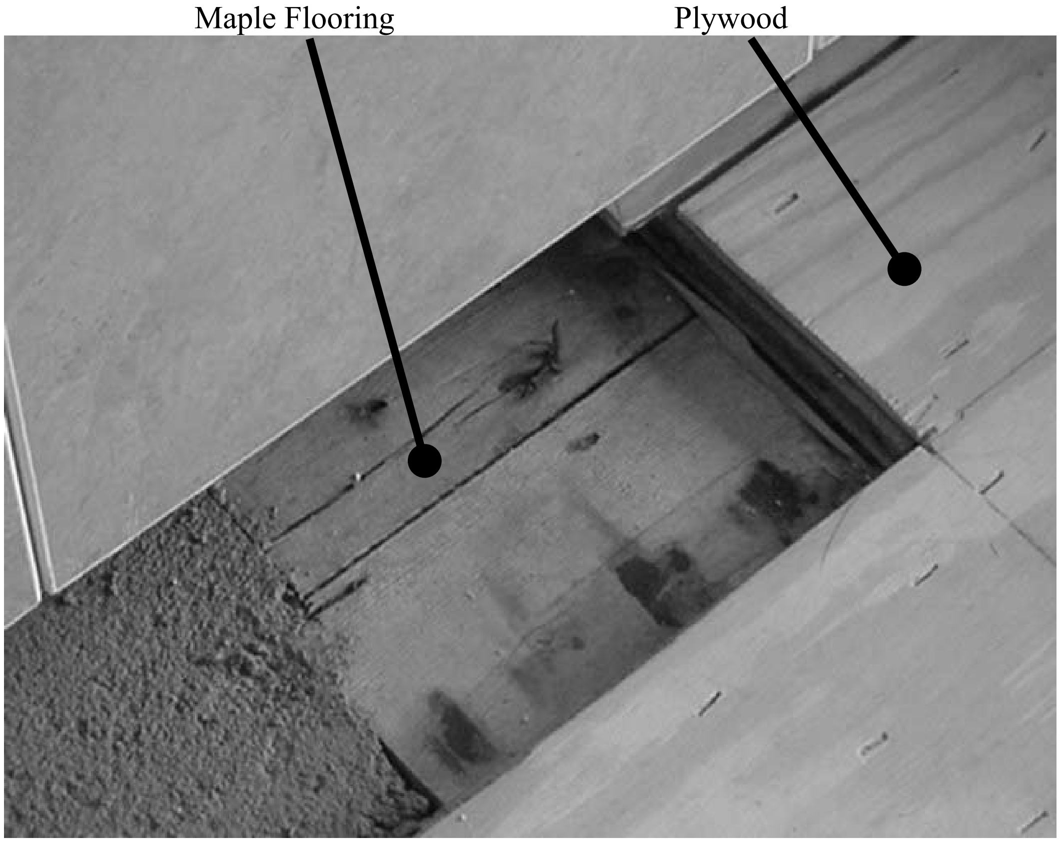
CDC. 1998. Compendium of Measures to Control Chlamydia psittaci Infection Among Human (Psittacosis and Pet Birds (Avian Chlamydiosis), 1998. *MMWR 47:RR-10. July 10, 1998.*

MDPH. 1999. Indoor Air Quality Assessment Norfolk Probate Court, Dedham, Massachusetts. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

SMACNA. 1995. IAQ Guidelines for Occupied Buildings Under Construction. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

Picture 1

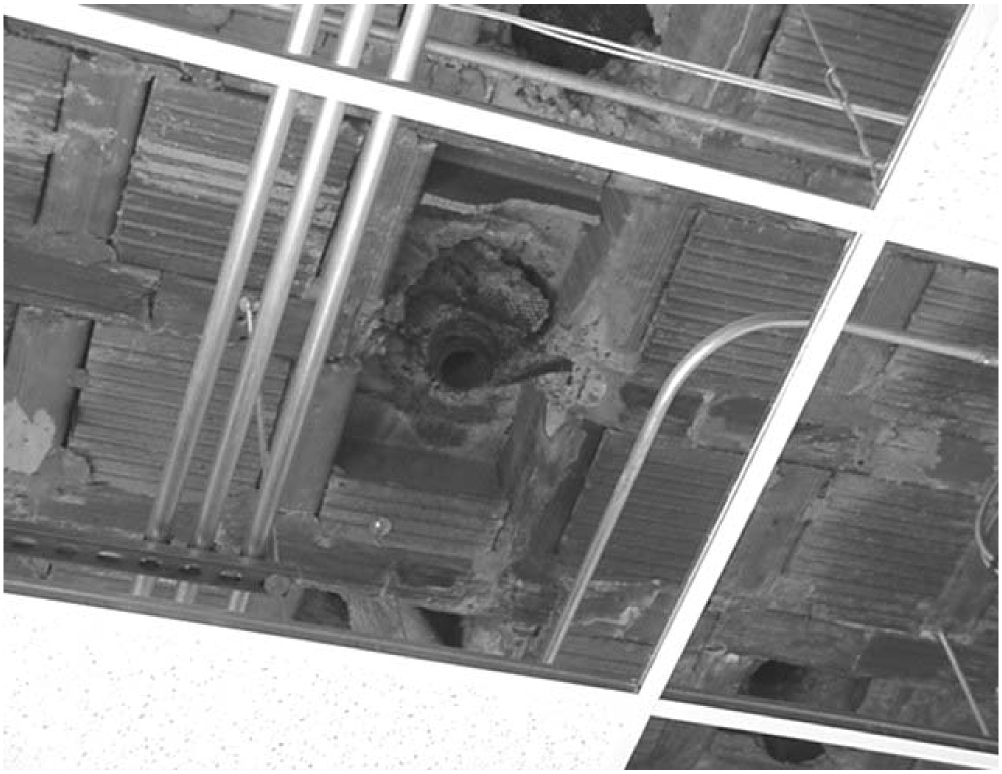


Flooring of the GMS

Picture 2

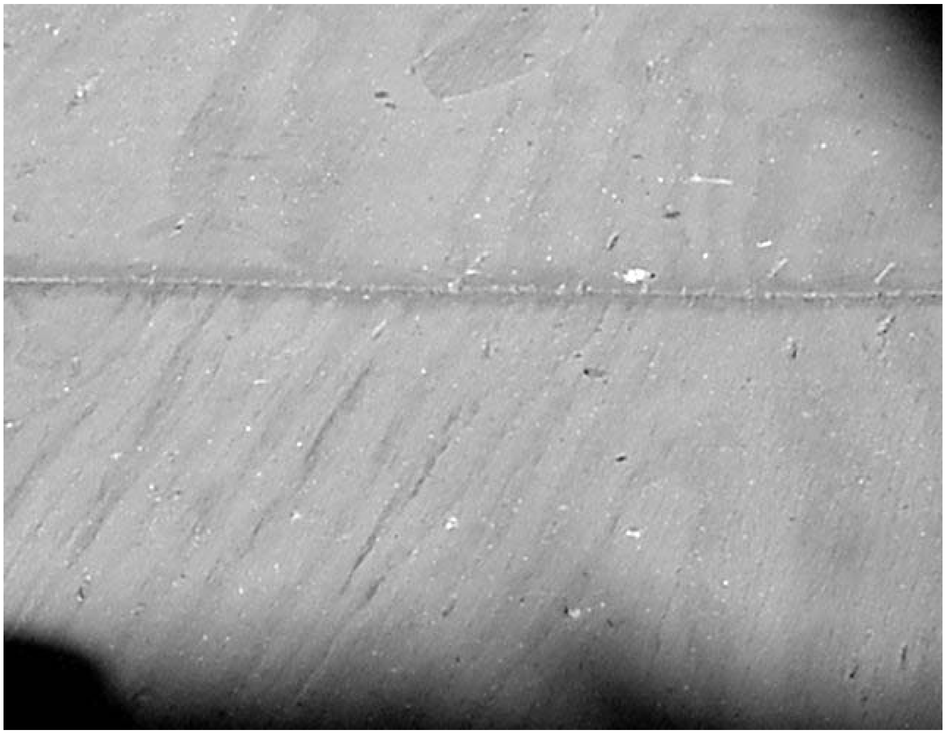
Brick Support Structure of Floor

Picture 3



Disconnected Roof Drain

Picture 4



Water Stain along Plywood Floor Seams

Picture 5

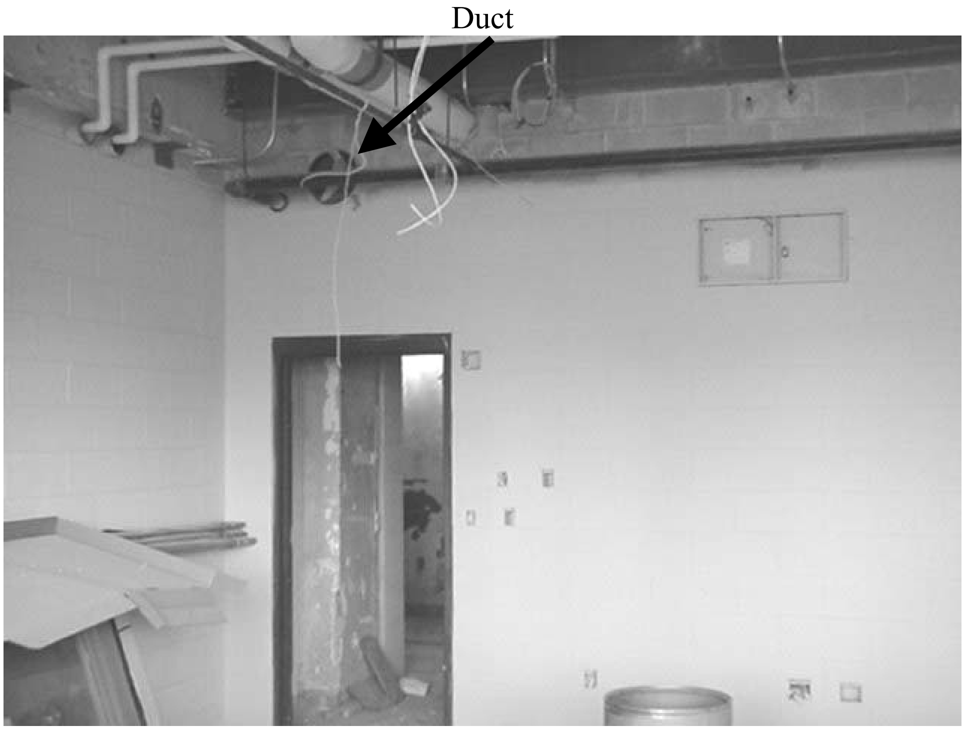
Bubbled Paint Sampled for Moisture Concentration

Picture 6

Duct

Unsealed Duct above Classroom Hallway Door

Picture 7



Unsealed Duct above Classroom Hallway Door

Picture 8

Close-Up of Unsealed Duct above Hallway Door

Picture 9

Ductwork to Be Installed Stored on Classroom Floor

Picture 10

Dust Contaminated Ductwork, Line Drawn in Dust by BEHA Inspector

Picture 11

Openings in Plastic Sheeting in Basement

Picture 12

Open Window on Second Floor

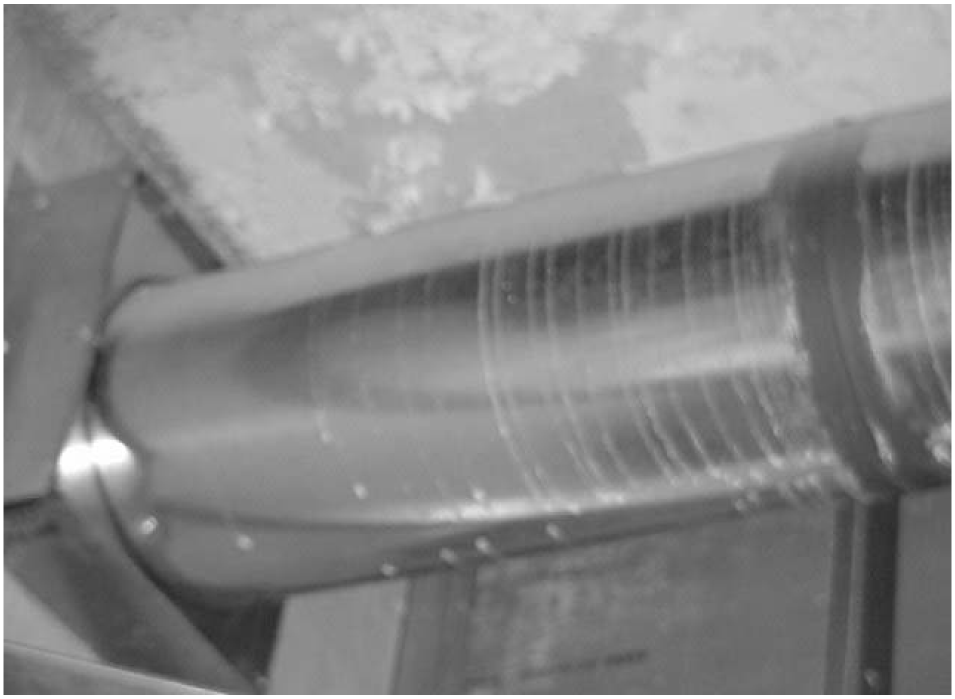
Picture 13

Pigeon inside the Gymnasium

Picture 14

Bird Feather on Floor of Classroom

Picture 15



Bird Wastes Contaminated Ductwork

Picture 16

Bird Waste Contaminated Pipe Insulation

Picture 17

Bird waste Contaminated Beams above Auditorium Stage

Picture 18

Close-Up of Bird Waste Contaminated Beam